Australian Sweet Lupin Health Review

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QUICK COOK LUPIN

MADE FROM AUSTRALIAN SWEET LUPIN

Lupin is a highly nutritious, easily digestible, world-class food product. It is arguably the highest source of natural, unprocessed protein ingredient in existence and may exceed all flour sources, processed and unprocessed, in proteins, digestibility and the bio-availability of essential nutrients.

Lupin is one of the highest sources of dietary fibre: 40g per 100g flour dry basis.

Lupin is high in essential amino acids, cholesterol free, contains **negligible amounts of Trypsin Inhibitors,** known to interfere with digestion often found in other legumes.

Lupin is also **very low in Lectins and Saponins**, two known gastric irritants, the latter of which afflicts the soybean even after extensive baking and processing.

Lupin is also **low in Phytic Acid**, which in the soybean, due to its higher content, binds with calcium and zinc, rendering them nutritionally unavailable.

Lupin does not require heat or chemical treatment, thus rendering it a superbly healthy food, by any standards.

Lupin does contain a modest amount of bio-active sugars ~8% oligossacharide sugars. Oligosaccharides are utilised as nutritional supplements to promote the growth of beneficial intestinal bifidobacteria (prebiotics) that improve the resistance to gastrointestinal infections caused by Escherichia coli, Clostridium and Salmonella spp

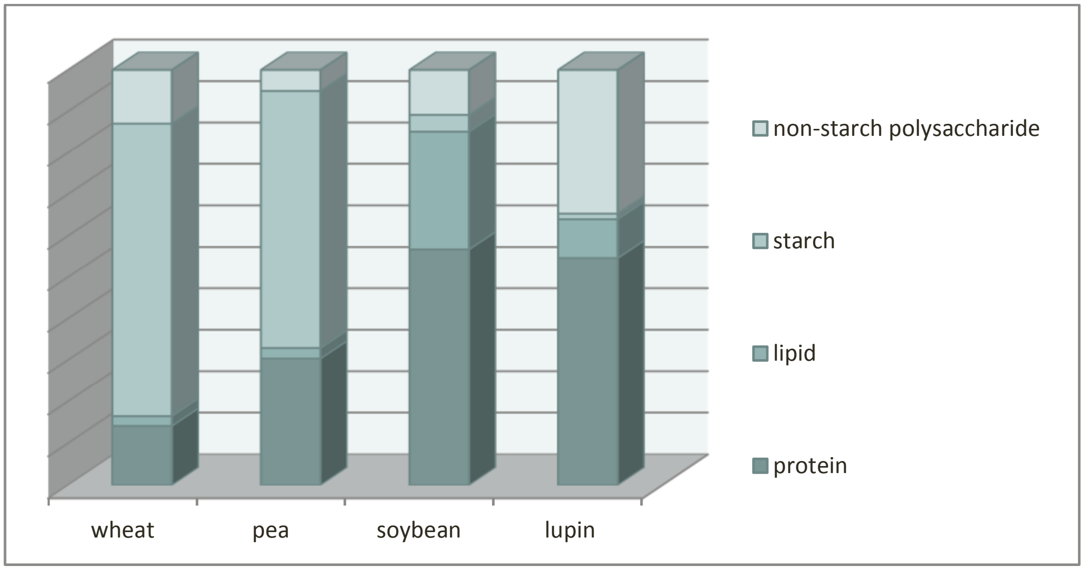
Studies have revealed that Australian Sweet Lupins:

- **Suppresses Appetite**
- **Reduce blood pressure**
- **Improve glucose metabolism (diabetes)**
- **Improve bowel health**
- **Prebiotic, promotes growth of good bacteria**
- **Reduce the Glycemic Load of carbohydrate foods**
- **Modify the Glycemic Index**
- **Very high source of essential amino acid**
- **Gluten free**
- **Non GMO**

SEE PAGES X-X FOR COMPREHENSIVE TABLES DETAILING SUPPORTING EVIDENCE.

LUPIN THE GRAIN WITHOUTH STARCH

Fig. 1 compares Lupin proximate analysis with other Grains



LUPIN ADDS NUTRITION

Adding about 20% lupin QCL to wheat flours will give a product with similar properties to the wheat product, but with an improvement in amino acid score from under 40% to over 80% relative o egg albumin (Uauy et al., 1995). Below is a table comparing the macronutrient profile of wheat flour and lupin QCL.

TABLE 1. COMPOSITION OF LUPIN FLOUR VS WHEAT FLOUR

	white flour	QCL/lupin	lupin vs wheat
	grams per 100 gram flour		
moisture	10	10	100%
protein	11	42	382%
fat	2	7	300%
ash	0.3	0.5	167%
carbohydrate	74.5	3.5	18%
fibre*-pectic	2	29	1400%
fibre* -oligosaccharides	0.5	8	1600%
Total	100	100	
Energy			
kj	1501	1024	68%
calories	366	250	68%

fibre*: lupin contains approximately 29-30% Non-starch polysaccharide pectic like fibres, however it also contains 6-8% oligosaccharides also classed as dietary fibre.
NB: Wheat and Lupin are biological materials therefore all parameters will vary slightly depending on variety and growing conditions.

TABLE 2. IMPROVING NUTRITION WITH THE ADDITION OF LUPIN							
			Blends - % substitution of (QCL) for white flour				
	white flour	lupin QCL	5%	10%	15%	20%	20% LUPIN IMPROVES THE NUTRITIONAL PROFILE
			g per 100g				
moisture	10.0	10.0	10.0	10.0	10.0	10.0	
protein	11.0	42.0	12.6	14.1	15.7	17.2	protein up by 56%
fat	2.0	6.0	2.2	2.4	2.6	2.8	
ash	0.5	0.5	0.3	0.3	0.3	0.3	
fibre	2.0	36.0	3.7	5.4	7.1	8.8	fibre up by 340%
carbohydrate	74.5	5.5	71.1	67.6	64.2	60.7	glycemic load down by 20%
Total	100	100	100	100	100	100	
Energy							
kj	1501	1024	1477	1453	1429	1405	energy reduced by 32%
calories	366	250	360	354	349	343	

PROTEIN AND PROTEIN QUALITY

LUPIN – HAS NO ANTI-NUTRITIONAL ELEMENT. IT DOES NOT REQUIRE HEAT TREATMENT OR SOLVENT TREATMENT

Therefore its protein content is not denatured and remains in a highly soluble and bioavalable form.

- Lupin is one of the top 3 natural sources of arginine.
- The essential amino acid profile (except sulphur-containing amino acids) of lupin is close to the amounts recommended by WHO
- lupin protein with methionine supplementation – has a true digestibility of over 90%.
- lupin proteins balance the lysine content of cereal products, and cereal products balance the low sulphur amino acids of lupin.

Yáñez et al. (1985) showed that adding lupin (L. albus) flour to wheat flour improved protein concentration, amino acid score and PER in rats. Schoeneberger et al (1983) report that raw as well as processed lupin protein showed an excellent apparent digestibility (80.0–85.8%; casein, 87.1%). The observed NPU and BV values confirmed the importance of methionine supplementation. The true digestibility of 92% was equivalent to that of casein. The complementation effects of mixing lupin protein with proteins from wheat, oat, barley, rice, maize, resulted in PER values that exceeded by far those of the proteins fed separately (true complementation). These mixtures resulted in PER values equal to those for casein or other animal proteins and may be applied as an economical way to prevent and combat malnutrition.

Lupin protein is easily digestible by humans. The bioavailability and post prandial utilisation of sweet lupin (Lupinus albus)-flour protein is similar to that of purified soyabean protein in human subjects: a study using intrinsically N-labelled proteins, Mariotti et al., 2001. Giampietro et al (2008) the authors of the paper "Acceptability of lupin protein products in healthy competitive athletes" had this to say:

> ***"Currently, however, there is growing interest in the use of lupin proteins, since lupin seed is characterised by a very high protein percentage and a relatively low content of antinutritional factors with respect to other legumes, and contains negligible amounts of phytoestrogens. This last feature may avoid the potential problems that have been recently indicated for these hormone-like components that are very abundant in soy proteins. Lupin proteins are nutritionally satisfactory, and have a neutral flavour, allowing the production of food items with optimal sensory characteristics."***

Table 3. Amino Acids requirements of Humans; Amino acids of white flour, lupin (QCL) & egg albumin

	WHO# Amino acid requirement	wheat flour	lupin flour	egg albumin (egg white)	
Protein (g/100g)		**11**	**42**	**5**	
The Essential Amino Acids		**g per 100g of protein**			
Tryptophan	0.7	1.0	1.0	1.18	
Threonine	2.7	2.1	3.5	3.41	
Isoleucine	2.5	2.6	3.9	5	
Leucine	5.5	4.8	6.9	6.8	
Lysine	5.1	**2.3***	4.8	4.6	**** Deficiency***
Methionine+Cystine	2.5	2.7	**2.0#**	4.9	***# Deficiency***
Phenylalanine+Tyrosine	4.7	4.4	7.6	8.15	
Valine	3.2	3.3	3.8	6.02	
Histidine	1.8	3.6	2.6	1.67	

WHO = World Health Organisation - Adults recommended requirement for essential amino acid

Table 4. Protein quality improves significantly by 20% lupin (QCL) substitution of white flour

	wheat flour	Lupin flour	80:20 blend	final protein quality	
	80g	20g	100g	%	
Protein delivered	**8.8**	**8.4**	**17.2**	**17.2**	
Amino Acids delivered	**grams**	**grams**	**grams**	**g per 100g of protein**	
Tryptophan	0.09	0.08	0.17	**1.2**	
Threonine	0.18	0.30	0.48	**3.4**	
Isoleucine	0.22	0.33	0.55	**3.9**	
Leucine	0.42	0.58	1.00	**7.1**	
Lysine	0.21	0.40	0.61	**4.3***	***79% improvement**
Methionine+Cystine	0.24	0.17	0.41	**2.9#**	**#45% improvement**
Phenylalanine+Tyrosine	0.39	0.63	1.02	**7.3**	
Valine	0.29	0.32	0.61	**4.3**	
Histidine	0.32	0.22	0.53	**3.8**	

NB: at this inclusion rate the 'dry ingredient component ie flour' is deliveing a significant amount of protein, 17g per 100g, as well as being almost a 'complete protein equal to egg white.

NSI AND PDI

The nitrogen pH-solubility curves obtained for 'unprocessed' legume are generally very similar and assume a deep V profile with a minimum in the rage of pH 4-5.5 and two maxima, above pH8 and below pH 2. Given this in terms of Quick Cooked Lupin approximately 60% protein solubility at a pH of 6.7 (Ruiz and Hove 1979) and over 90% solubility at pH 1 and pH 9. At 10% dispersion (100g Lupin flour/1000g water) = pH 5.5.

Ruiz L and Hove L (1976) J. Sci. Food Agric. Vol 27 pp661

FIBRE

Diets naturally high in fiber can be considered to bring about several main physiological consequences:

- help prevent constipation
- reduce the risk of colon cancer
- improve gastrointestinal health
- improve glucose tolerance and the insulin response
- reduction of hyperlipidemia, hypertension, and other coronary heart disease risk factors
- reduction in the risk of developing some cancers
- increased satiety and hence some degree of weight management

These effects are not due to a single fiber type but **the summation of the different fibre classes in the diet.**

LUPIN FIBRE CONTAINS THREE ELEMENTS OF THE FIBRE CLASSES:

- **SOLUBLE**
- **INSOLUBLE**
- **OLIGOSACCHARIDES (PREBIOTIC)**

SOLUBLE FIBRE**:** When soluble fiber is fermented, short-chain fatty acids (SCFA) are produced. SCFA are involved in numerous physiological processes promoting health, including:

- lower colonic pH (i.e., raises the acidity level in the colon) which protects the lining from formation of colonic polyps and increases absorption of dietary minerals
- provide nourishment of colonocytes, particularly by the SCFA butyrate
- improve barrier properties of the colonic mucosal layer, inhibiting inflammatory and adhesion irritants, contributing to immune functions
- stabilizing blood glucose levels by acting on pancreatic insulin release and liver control of glycogen breakdown
- stimulate gene expression of glucose transporters in the intestinal mucosa, regulating glucose absorption
- suppress cholesterol synthesis by the liver and reduce blood levels of LDL cholesterol and triglycerides responsible for atherosclerosis
- stimulate production of T helper cells, antibodies, leukocytes, cytokines, and lymph mechanisms having crucial roles in immune protection

SCFA that are absorbed by the colonic mucosa pass through the colonic wall into the portal circulation (supplying the liver), and the liver transports them into the general circulatory system. Overall, SCFA affect major regulatory systems, such as blood glucose and lipid levels, the colonic environment, and intestinal immune functions. The major SCFA in humans are butyrate, propionate, and acetate, where butyrate is the major energy source for colonocytes, propionate is destined for uptake by the liver, and acetate enters the peripheral circulation to be metabolized by peripheral tissues. Studies have demonstrated positive effects on calcium and other mineral absorption, immune system effectiveness, bowel pH, reduction of colorectal cancer risk, inflammatory bowel disorders (Crohn's Disease and Ulcerative Colitis) Hypertension (high blood pressure) and intestinal regularity. Recent human trials have reinforced the role of Prebiotics in preventing and possibly stopping early stage colon cancer. It has been argued that many of these health effects emanate from increased production of short-chain fatty acids (SCFA) by the stimulated beneficial bacteria. Thus foods specifically enhancing the growth of SCFA producing intestinal bacteria (such as clostridia and bacteroides species) are widely recognized to be beneficial.

Human colonic bacteria substrates are relatively stable. Production of SCFA and fermentation quality are reduced during long-term diets of low fiber intake. Until bacterial flora are gradually established to habilitate or restore intestinal tone, nutrient absorption will be impaired and colonic transit time temporarily increased with an immediate addition of higher prebiotic intake.

Insoluble Fibre: Dietary fibre, particularly insoluble fibre, increases stool weight and, decreases gut transit time and in so doing, helps to relieve constipation. Insoluble fibre, is resistant to fermentation in the gut and is excreted in the faeces. It increases stool weight by holding water.
Benefits of insoluble fibre; by improving bowel function, dietary fibre can reduce the risk of diseases and disorders such as diverticular disease, haemorrhoids and constipation. Increased faecal bulk and decreased transit time allows less opportunity for carcinogens to interact with the walls of the intestine. Similarly, fibre may reduce the toxic effect of heavy metals and pesticides.

Pre-biotics: are non-digestible food ingredients, such as oligosaccharides, which are used as a source of fuel for bacteria in the gut. Without food, these bacteria cannot survive and perform their beneficial effects in the large bowel. Oligosaccharides have been shown to stimulate the growth and/or activity of beneficial bacteria, such as bifidobacteria, and to reduce the concentration of pathogenic bacteria, such as Escherichia coli, Clostridia, and bacteroides. Hence pre-biotics contribute to the overall health of the bowel. Oligosaccharides have been shown to reduce the severity of bacterially induced diarrhoea. Oligosaccharides have been used to protect the probiotic bacteria during processing and consumption.

Prebiotics, Gut Micro- biota and Obesity

Extracted from: Gut Microbiota and Its Possible Relationship With Obesity, Mayo Clinic Proceedings April 2008 vol. 83 no. 4 460-469

> *"Recent evidence suggests that the trillions of bacteria that normally reside within the human gastrointestinal tract, collectively referred to as the gut microbiota, affect nutrient acquisition and energy regulation; it further suggests that obese and lean people have different gut microbiota. These findings raise the possibility that the gut microbiota has an important role in regulating weight and may be partly responsible for the development of obesity in some people."*
>
> *"Kalliomäki et al*[71] *prospectively followed children from birth to age 7 years. Fecal samples collected at ages 6 and 12 months were analyzed using a variety of molecular techniques. Higher numbers of bifidobacteria and lower numbers of* Staphylococcus aureus *were found in children who were normal weight at age 7 years than in those who*

*were overweight-obese****, suggesting that differences in the composition of the gut microbiota precede overweight-obesity."***

Does Lupin Cause Intestinal Discomfort?

Giampietro et al (2008), conducted a study, specifically designed to look at such issues, using sports athletes (highly sensitive demographic), as the subjects. They wrote:

> *"Interestingly, no subject showed any burping or retrosternal, discomfort, i.e., characteristic of oesophageal reflux [20]. All scores were close to 0, thus indicating that all the products passed through the upper digestive tract easily, with no particular discomfort. There was no nausea/malaise, all scores being close to 0. Particularly, there was no malaise or nausea in any subject after consumption of both the chunks and gyros. However some loss of appetite was reported with most of these products. The most replenishing food item was the steak, whereas a lesser appetite suppression was noted with chunks and gyros. Essentially, there was no evidence of bloating, with very low scores, and, similarly, there were essentially no reports of significant abdominal cramps or epigastric pain."*

LUPIN HEALTH STUDIES

POTENTIAL EFFECT	Title & Author	Results	Date	Model
SATIETY	Lupin enriched bread increases satiety & reduces energy intake acutely ; Ya P Lee et al.	4 weeks, 16 volonteers. White bread or lupin bread. ↑ satiety with lupin bread : reduction of energy intake. ↓ ghreline (satiety hormone) 3hours after meal.	2006	Human
	Effect of fat replacement by inulin or lupin-kernel fibre on sausage patty acceptability, post meal perceptions of satiety and food intake in men ; B J Archer et al.	3 healthy men, control sausage or fat reduced sausage (with inulin or lupin kernel fibre).Lupin kernel fibr sausage is more satiating than either with inulin or fullfat control sausage. ↓energy intake.	2003	Human
GLYCEMIC INDEX	Australian sweet lupin flour addition reduces the glycaemic index of a white bread breakfast without affecting palatability in healthy human volunteers ; RS Hall et al.	11 healthy subjects, white bread or LKF bread : ↓ GI, ↑ II, no variation of satiety, palatability, food intak	2005	Human
	Sensory acceptability of white bread with added Australian sweet lupin (angustifolius) kernel fibre and its glycaemic and insulinaemic responses when eaten as a breakfast ; SK Jonhnson et al.	21 healthy adults. Lupin kernel fibre bread vs white bread ; ↓ 18% insulin with LKF bread	2003	Human
INSULIN & DIABETES	Use of lupin conglutin for the treatment of type II diabetes ; Paolo Morazzoni et al. (128) + associated references	Hypoglycemising action of lupin protein, ↓ plasma curves after glucose administration in the rats	2008	Human
	Conglutin gamma, a lupin seed protein, binds insulin in vitro and reduces plasma glucose levels of hyperglycemic rats ; Magni et al.	Pretreatment –oral administration of g-conglutin (top dose =200mg/kg) 30 mins before oral glucose challenge. Metformin positive control. Significant dose dependent reduction AUC for glucose.	2008	mouse
BLOOD PRESSURE	Protein, fibre and blood pressure : potential benefit of legumes ; Lee et al.	Proteins and fibres from legumes allow to improve blood pressure	2008	Human
	Effects of lupin kernel flour-enriched bread on blood pressure : a controlled intervention study ; Ya P Lee et al.	Increasing protein and fiber in bread with lupin kernel may be a simply dietary approach to help reduce blood pressure and cardiovascular risk.	2008	Human
	Lupin protein attenuates the developpement of hypertension and normalises the vascular function of NaCle-loaded Goto Kakizaki rats ; Pilvi et al.	Diabetic rats : Lupin, Soy or control diet + NaCl (↑hypertension), for 2 weeks. ↓ SBP : -18,6 with lupin diet & -12mmHg with soy diet	2006	Rat
BOWEL HEALTH	Volatile Fatty Acid production from lupin meal in the caecum of the rat : the role of cell wall polysaccharides and alphagalactosides ; Champ et al.	Of the VFA production arising from the ingestion of lupin meals, 50% appears to be derived from non-starchy polysaccharides, and 50% from the α-galactosides (oligosaccharides), **lupin butyrate cf control ↓ pH of ceacum**.	1991	Rat
	Lupin kernel fibre foods improve bowel function and beneficially modify some putative faecal risk factors for colon cancer in men ; Johnson et al.	38 healthy men, LKF or control diet for 1 month. With lupin diet : ↑ frequency of defacation, faecal output & faecal moisture, ↓ transit time and faecal pH. ↑ **faecal butyrate concentration (40%)**.	2006	Human
	Influence of pea and lupin oligosaccharides on caecal short chain fatty acids production and nitrogen excretion pattern in rats; Juskiewicz et al.	Casein diet – control 5% cellulose. Experimental 3.9% lupin and 4.9%pea oligosaccharide. Both ↑ SCFA production, **lupin ↑ butyrate**, pea ↑ proprionate & acetate production.	2006	Rat

POTENTIAL EFFECT				
PREBIOTIC	Biological Activity of a�Galactoside Preparations from Lupinus angustifolius and Pisum sativum Seeds; Gulewicz	Oligosaccharide extracts (a�galactosides), were tested on colon flora. ↑ Beneficial colon bacterium strains, concomitantly ↓ coliforms	2002	Rat
	Raffinose family of oligosachharides from lupin seeds as prebiotics : application in dairy products ; C Martinez Villaluenga et al.	↑ Bifidobacterium lacti Bb-12 and Lactobaccilus acidophilus in probiotic fermented milk.	2004	Human
	Lupin kernel fibre consumption modifies faecal microbiota in healthy men as determined by rRNA gene fluoresent in situ hybridization ; Smith et al	18 healthy men. Consumption of lupin kernel fibres (<17g/day) for 28 days. ↑colonic bifidobacteria growth, LKF may be considered as a prebiotic and may beneficially contribute to colon health	2006	Human
	Raffinose family oligosaccharides of lupin (L. albus) as potential prebiotic. Martinez Villaluenga et al.	Dose 150mg/kg body weight lupin oligosaccharides. ↑feacal bifidobacteria.	2007	Rat
	The Inclusion of Lupin (L. angustifolius) seed mean or its fibre residue in the diet reduces the levels of Escherichi coli in both SMALL and LARGE INTESTINE of the rat; Rubio et al	Lupin containing diets ↓ ***E. coli*** in the caecum, colon and **small intestine**.	1995	Rat
CHOLESTEROL & TRIGLECERIDES	Hypolipidaemic and antiatherosclerotic effects of lupin proteins in a rabbit model ; Marta Marches et al.	Lupin Protein Isolate vs Casein and Control diets for 90 days. After 60 and 90 days with lupin : ↓ cholesterol (-40% & -33%) and ↓ athrosclerosis (-37% lesion)	2007	Rabbit
	Cholesterol-lowering effects of dietary lupin (Lupinus albus var. Multilupa) in chicken diets ; Viveros et al.	Lupin or Casein diets for 3 weeks. With lupin : ↓ plasma LDL-cholesterol & tot. cholesterol, ↑ hepatic LDL receptor synthesis & HMG-Co1 reductase activity, ↑ instestinal bile acid reabsorption	2007	Chicken
	Effect of lupin protein (L.albus) on cardiovascular risk factors in smokers with mild hypercholesterolemia ; Naruszewicz et al.	55 subjects(smokers).Consumption of 500ml of lupin milk per day, for 3 months. ↓ cholesterol – LDL cholesterol - plasma TG and blood pressure.	2006	Human
	Cholesterol-lowering effects of dietary blue lupin (Lupinus angustifolius) in intact and ileorectal anastomosed pigs, Martins et al.	↓LDL	2005	Pigs
	Lupin kernel fibre-enriched foods beneficially modify serum lipids in men ; RS Hall et al.	38 healthy men - LKF vs Control diet - 1 month. Lupin diet : ↓ total cholesterol & LDL ch.	2004	Human
	Proteins of white lupin seed, a naturally isoflavone poor legume, reduce cholesterolemia in rats and increase LDL receptor activity in HepG2 cells ; Sirtori et al.	In rats : ↓ LDL cholesterol in plasma (21%) In vitro (human cells) : ↑ of LDL uptake (53%) and LDL degradation (21%)	2003	Rat + In vitro
	Development of food products containing lupin fiber and their effects in elderly people; Bunger et al.	44 subjects – 5 weeks. Good results for weight – IMC – cholesterol - LDL Human	1999	Human
	Lupin protein influences the expression of hepatic genes involved in fatty acid synthesis and triacylglycerol hydrolysis of adult rats ; Bettzieche et al.	Egg albumin-based diets + lupin or casein (supplemented or not) for 22 days. Compared to casein, lupin diet : ↓ TAG in the liver, plasma & VLDL + chylomicrons, ↓ protein concentration in VLDL + chylomicrons, ↓ mRNA concentration of SREBP-1c & fatty acid synthase in the liver		Rat
	Dietary lupin protein lowers triglyceride concentrations in liver and plasma in rats by reducing hepatic gene expression of sterol regulatory element-binding protein-1c ; SpilmannJ et al	In rats (n=12 x2), 22 days, control casein. ↓ VLDL +chylomicrons ↓ protein in VLDL ↓ triglycerides (liver & plasma)	2007	Rat

RELEVANT PUBLICATIONS:

Br J Nutr. 2002 Apr;87(4):315-23

The bioavailability and postprandial utilisation of sweet lupin (Lupinus albus)-flour protein is similar to that of purified soyabean protein in human subjects: a study using intrinsically 15N-labelled proteins.

Mariotti F, Pueyo ME, Tomé D, Mahé S.

Abstract: Sweet lupin (Lupinus albus), a protein-rich legume devoid of anti-nutritional factors, is considered to have a high potential for protein nutrition in man. Results concerning the nutritional value of lupin protein are, however, conflicting in animals and very scarce in human subjects. Furthermore, where fibre-rich protein sources are concerned, the long-term nutritional results are often obscured, particularly since fibre-promoted colonic fermentation may bias the energy supply and redistribute N flux. We therefore studied, during the postprandial phase, the bioavailability and utilisation of lupin-flour protein in nine healthy men who had ingested a mixed meal containing intrinsically 15N-labelled lupin flour as the protein source (Expt 1). The real ileal digestibility (RID) and ileal endogenous N losses (IENL) were assessed using a perfusion technique at the terminal ileum, and the N content and 15N enrichment of ileal samples. Lupin flour exhibited a high RID of 91 (SD 3)% and low IENL (5-4 (SD 1.3) mmol N/h). Postprandial dietary deamination was also assessed from body dietary urea and urinary dietary N excretion, and compared with results in nine healthy men following an iso-energetic meal containing a 15N-soyabean-protein isolate with a similar RID, as a control (Expt 2). Postprandial dietary deamination was similar after lupin and soyabean meals (17 (SD 2) and 18 (SD 4)% ingested N respectively). We therefore conclude that lupin protein is highly bioavailable, even if included in fibre-rich flour, and that it can be used with the same efficiency as soyabean protein to achieve postprandial protein gain in healthy human subjects. PMID: 12064341 [PubMed - indexed for MEDLINE]

Journal of Nutrition. (1992) Vol 122:pp2341-2347

Sweet Lupin Protein Quality in Young Men

Juan I. Egaña*,†,1, Ricardo Uauy*, Ximena Cassorla*, Gladys Barrera* and Enrique Yañez*

Abstract: The protein quality of Lupinus albus cv Multolupa was evaluated in young adult males using the nitrogen balance technique at graded levels of N intake, and compared with egg protein. Lupin protein was consumed at levels of 0.4, 0.6 and 0.8 g/(kg·d) and egg protein at 0.3, 0.45 and 0.6 g/(kg·d). Each period started with 1 d of consuming a protein-free diet; the next 6 d were used as adaptation and the last 4 d for balance. The levels of protein intake were randomly assigned by a modified Latin square. Energy intake was individually adjusted. Mean apparent N digestibility values of lupin protein were 78.8, 76.1 and 70.2% for the levels of 0.8, 0.6 and 0.4 g protein(kg·d), respectively, and 83.8, 78.3 and 67.1% for egg protein consumed at levels of 0.6, 0.45 and 0.3 g protein/(kg·d), respectively. The N balance results obtained when subjects consumed lupin were 16.4, 0.2 and -15.1 mg N/(kg·d) for protein intakes of 0.8, 0.6 and 0.4 g/(kg·d), respectively. Those obtained for egg consumption were 12.6, -3.6 and -17.1 mg N/(kg·d) for protein intakes of 0.6, 0.45 and 0.3 g/(kg·d), respectively. The linear regressions of intake and absorbed N to retained N for lupin were: N retained = -43.41 + 0.50 N intake and N retained = -36.30 + 0.53 N absorbed. The corresponding regressions for egg were: N retained = -45.0 + 0.65 N intake and N retained = -30.65 + 0.58 N absorbed. The net protein utilization of lupin was 77% that of egg protein.

Plant Foods for Human Nutrition (Formerly Qualita Plantarum). 1983 (32):133-143

The protein quality of lupins (Lupinus mutabilis) alone and in combination with other protein

H. Schoeneberger1, 2, R. Gross1, 2, H. D. Cremer1, 2 and I. Elmadfa1, 2

Abstract: The chemical compositions, of raw and treated lupine flour were determined and compared with other plant protein sources. The protein content in the dry matter was 47.7% in untreated seeds ofLupinus mutabilis and about 56% in debittered seeds. The oil-cake contained 65.3% protein. The amino acid analysis showed that lupine protein is characterized by a low level of S-amino acids, the content of which amounts to only 50% of that of the FAO standard reference pattern. The protein quality was measured using the biological tests PER (Protein Efficiency Ratio), NPU (net protein utilization), and BV (biological value) in rats on diets with and without DL-methionine supplementation. PER determinations gave low values for the non-supplemented lupine proteins (1.34, semi-sweet variety; 1.53, water-extracted seeds; 1.19, oil-cake; 3.09, casein), but the PER's were improved by the addition of 0.2% DL-methionine to the diets (3.05, 2.69, 2.81, respectively). Raw as well as processed lupine protein showed an excellent appar
ent digestibility (80.0–85.8%; casein, 87.1%). The observed NPU and BV values confirmed the importance of methionine supplementation. The true digestibility of 92% was equivalent to that of casein. The complementation effects of mixing lupine protein with proteins from wheat, oat, barley, rice, maize, potato, quinua or fish were investigated by determination of the PER values of the respective mixtures. Feeding lupine protein with cereal proteins resulted in PER values that exceeded by far those of the proteins fed separately (true complementation). This result was not observed for the mixture of potato and lupine. High quality proteins like quinua and fish protein also showed no complementation effect with lupine protein but did improve the quality of the lupine protein to a great extent. The best results could be obtained with combinations of three different plant proteins, in which lupine protein always contributed one third of total protein. These mixtures resulted in PER values equal to those for casein or other animal proteins and may be applied as an economical way to prevent and combat malnutrition.

Sport Sci Health (2008) 3:65–71

Acceptability of lupin protein products in healthy competitive athletes

Giampietro Alberti · Cesare R. Sirtori · Marcello Iriti · Anna Arnoldi

Abstract Lupin proteins allow the preparation of some innovative protein-rich food products, e.g., steaks, chunks, cutlets, gyros. With the objective of evaluating the acceptability of these foods in sport nutrition, they were provided to 34 healthy competitive track and field athletes (mean age 25±5, 17 males and 17 females), to be taken before training or a competitive event. Athletes were asked to fill in 3 different questionnaires, reporting possible problems/negative symptoms impacting on acceptability: questionnaire 1 had to be filled in 1 h after food intake, questionnaire 2 immediately after training/competition (i.e., 3–5 h after food intake) and questionnaire 3 on the day after. All 34 participating athletes indicated good satisfaction with the food products, which were generally well accepted. In addition, most of the athletes gave positive reports in terms of sense of satiety, sense of energy and desire to exercise. Therefore, lupin proteins may provide a useful, well accepted approach to pre-exercise nutrition in competitive athletes.

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